Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

AHW27-P01 Room:Convention Hall Time:May 24 17:15-18:30

Changes in shallow groundwater chemistry over the past 75 years in the Musashino Plateau, central Tokyo, Japan

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Changes in shallow groundwater chemistry from the 15-17 m deep wells of the Suginami Water Purification Plant, central Tokyo, over the past 75 years were examined and anthropogenic and natural factors affecting them were discussed. The Long-term change in sulfate concentration proved to be totally different from those of chloride and nitrate-N & nitrite-N concentrations. Contribution of LAS (principal ingredient of synthetic detergent), leaking water from water mains and/or sewers to shallow groundwater are indicated as plausible factors accounting for a constant increasing trend in sulfate concentration over the past 75 years.

Keywords: Tokyo Metropolitan area, urban groundwater chemistry, long-term change, chloride concentration, nitrate concentration, sulfate concentration

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Laterality of pollutants derived from domestic waste water in shallow groundwater in the east Musashino upland

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We study on processes of groundwater recharge and addition of pollutants derived from domestic waste water to groundwater in the ward district of Tokyo Metropolis that is one of typical urban areas in Japan. In this presentation, we will show the laterality of pollutants that are derived from domestic waste water in a shallow unconfined aquifer in local scale. We took groundwater samples from five shallow wells in the east Musashino upland and analyzed major dissolved ions, stable isotopes of oxygen and hydrogen and PPCPs. Scale of the study area is about 1.5 km times 2 km.

Cl^- and $NO_3{}^-$ were found in the all samples and concentrations were from about 17 to 47 mg/L and from about 51 to 81 mg/L, respectively. These ions showed positive correlation. From the result of stable isotopes, these ions were derived from domestic waste water. Also, concentrations of both ions were correlated with land coverage. These results suggested that the leakage of domestic waste water was nonpoint source.

As for PPCPs, amantadine, carbamazepine, crotamiton, and N,N-diethyl-m-toluamide were detected. Although these substances have various uses, there was a tendency that several substances were detected simultaneously. However, there was no correlation between the concentrations of PPCPs and Cl^-, $NO_3{}^-$. From these results, it was suggested that distribution of PPCPs in groundwater in this area has high laterality.

Keywords: urban area, groundwater pollution, domestic wastewater, PPCPs, Tokyo Metropolis

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AHW27-P03 Room:Convention Hall Time:May 24 17:15-18:30

On the water quality of springs in the western part of Musashino upland

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In the urbanized area like in and around Tokyo Metropolitan district, the depletion of the amount of discharge of spring water and the changes in water qualities are caused by the changes in land use.

In this study, the author carried out the studied on the changes in water quality of spring water in the western part of Musashino upland, in tokyo metropolitan aria and intended to clarify the effects of the changes in land use. As a first step, the author attempts to investigate the relationship between changes in spring water quality and land use in the area from 1960s to 2010s.

The geomorphology of the study area consists of river terraces formed by the Tama River. For their geological structure, Tachikawa terrace and Aoyagi terrace are mainly formed by Tachikawa loam and gravel, Haijima terrace, lower than Aoyagi terrace, is formed by a gravel layer.

In this study, the author surveyed the spring water near the cliff terrace of Aoyagi and Haijima terraces. The field survey was carried out during the summer of 2011. The results are summarized in the graphs in chronological order to the data obtained in this survey and the data in published document.

From the results, the changes in the concentrations of major component in water qualities were lowered. The concentration of Cl^- is also declined, for example, the concentration of Cl^-,Suwa Shintoshrine of spring in Akishima city, was 31.5mg/l in 1968 summer,5.7mg/l in 2011 summer.

In the Tama district, including the western part of Musashino upland are, almost no facilities for sewage treatment up to1975, so sewage directly percolate in the hole ,digging in the ground (EPA of TMD, Tokyo, 1980). Recently, sewage treatment facilities were constructed and such non-hygienic systems were disappeared.

Changes in land use in this area, such as the periods; (a) farmland, (b) changing from farmland to residential land, (c) sewerage system equipped in the residential area.

Form the results of the study on water quality of spring water, changes in water quality of spring water is strongly affected from the sewerage system and land use on the terraces of the western Musashino upland.

Keywords: musashino upland, land use, spiring water, secular change

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Water Quality and Pollutant Load for Flood and Non-Flood Periods in Kanda River, Tokyo

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1. Introduction

Many urban small tidal rivers in Japan lack natural water sources. Besides at the time of storm, untreated water flows into these rivers through a combined sewer system, causing pollutant load. Sakai et. al. (2008) reported on a method using the *L-Q* equation to evaluate the pollutant load during storm. Meanwhile, the authors have arranged the characteristics of the flood, transition and tide phases based on the behaviour of the water quality parameters. This latest study aims at evaluating the characteristics of pollutant load during storm, focusing on the discharge and pollutant load in storm periods in an urban small tidal river.

2. Observation Method and Conditions

Observation was conducted from 8th to 10th September, 2010 at almost the central point of the river width at the Shin-Ryukei Bridge located some 4.4 km upstream of the river mouth of the Kanda River. The instruments used were a multi-parameter water quality meter and a two-axis electromagnetic current meter. Water samples were collected at the surface to analyse the BOD, COD and SS. At the Tokyo area, the total rainfall of 102.2 mm (67.0 mm/hour between 14:00 and 15:00 on 8th August) was observed in the period from 08:00 to 17:00 on 8th August. By 15:00, the river level had risen by some 1 m because of the storm.

3. Results and discussion

Following the storm, the velocity of the bottom layer increased. At 14:00 on 8th September, the salinity of the bottom layer was flushed out while the BOD, COD and SS values sharply increased. When the flow velocity had dropped to almost 0 cm/s, the SS value almost returned to its normal level. Flood phase indicates the period where the flow velocity gradually decreased to almost 0 cm/s after the flushing out of the bottom water. After the flood phase comes the transition phase which links between the flood phase and tide phase. The relationship between the discharge Q and pollutant load L is analysed using the *L-Q* equation ($L = aQ^b$ where a and b are the coefficients). Here, the data for the past storm events at the observation point are also used. When all of the discharge and the BOD load data are plotted, the coefficient of determination (R^2) is high at 0.81 with noticeable scattering in the low discharge range. In contrast, the correlation improves with the R^2 value of 0.95 when only the flood phase data are plotted. When the flood phase data are used, a high level of correlation is also suggested with R^2 values for the COD and SS of 0.96 and 0.94 respectively. This can be explained that the *L-Q* relationship for the flood phase is determined only by the load from the upstream with no influence of the load from the downstream (the Sumida River and Tokyo Bay) because the flood water of all layers flows downstream. To further examine the characteristics of the Kanda River, a comparison is made with coefficients a and b of the *L-Q* equation concerning the COD load for other rivers reported by Sakai et. al. (2008). The values of coefficients a and b concerning the COD load for the Kanda, Edo, Ara, Tama and Naka Rivers. The value of coefficient a for the Kanda River is much larger than that for the Edo, Tama and the other rivers, indicating the likelihood of a relatively large load being experienced due to small-scale flooding.

4. Conclusions

The study found a high level of *L-Q* correlation in the period from the flushing out of the bottom water to the point where the discharge becomes zero. Based on this newly confirmed *L-Q* correlation, the characteristics of urban small rivers where a high level of pollutant loading occurs with small-scale flooding are clearly established.

Keywords: Kanda River, tidal river, storm, BOD, COD, L-Q equation

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AHW27-P05 Room:Convention Hall Time:May 24 17:15-18:30

Analyzing faecal contamination of urban groundwater in Kathmandu Valley, Nepal

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Shallow groundwater is an important source of domestic water in the Kathmandu Valley. Previous studies have reported *E.coli* contamination in water samples from many public and domestic wells, in urban area of the valley. Every year, about 3000 deaths due to waterborne diseases are reported. Microbial pollution in the groundwater could probably be the reason behind the deaths. The objective of this study is to investigate faecal contamination source and its contribution in the groundwater of the Kathmandu Valley, Nepal

We collected groundwater samples from shallow tube wells and dug wells (depth: 2.8-21 m) and river water samples from main rivers in Jan.2009, Aug.2009, Aug.2009 and May.2011. Then, we measured *E.coli* concentration, water oxygen and hydrogen isotopes, nitrate nitrogen and oxygen isotopes, and other chemicals in the water samples.

Higher *E.coli* concentrations were detected in the river water and the dug well (unprotected well) samples compared to the tube well (protected well). The high *E.coli* in the river water samples reflected wastewater discharge to the river without treatment. The seasonal variation of the water oxygen isotope and chemical concentration for both the groundwater and the river water samples indicated that the interaction between river water and shallow groundwater is insignificant. Additionally, high delta 15N of nitrate in the high *E.coli* water samples indicated sewage as possible source of faecal contamination in the groundwater

Keywords: Groundwater, Faecal contamination, E.coli, Stable isotopes, Kathmandu valley

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AHW27-P06 Room:Convention Hall Time:May 24 17:15-18:30

Analysis of nitrate variation with quality and hydrological factors in urban groundwater of Kathmandu Valley, Nepal

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The occurrences of nitrate, nitrite and ammonium in shallow groundwater systems, with their sources and distributions mechanism were investigated in Kathmandu valley, Nepal. Thirty-five shallow groundwater samples were collected during the monsoon (August) season in 2009 and analyzed for the concentration of major dissolved ion and nitrate nitrogen and oxygen isotopes.

Nitrate isotopes approach suggests the sewer leakage act as a major source of nitrogen contamination. Relationships between dissolved oxygen and composition of nitrate and ammonium shows the leakage from sewers could be the primary ammonium source, which is then converted into nitrate with anaerobic condition. Furthermore, this liner relationship between nitrogen and oxygen isotopes in nitrate shows the active denitrification in shallow groundwater. Nitrate concentrations in the groundwater are decreased due to mixing with sewage originated nitrate and rainwater nitrate. And nitrate removal by the denitrification in shallow groundwater.

Keywords: Groundwater, Nitrate contamination, Sewage leaking, Nitrate nitrogen and oxygen isotopes, Kathmandu Valley

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Distribution and decadal changes of subsurface temperature in the northern Kanto Plain

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Since 1999, our group has been conducting a survey to evaluate the subsurface temperature environment in the Kanto Plain, Japan. Miyakoshi et al. (2003) showed the existence of high temperatures beneath the northern Kanto Plain. However, the reason why the high temperature area is formed has not been explained. To make clear a distribution of subsurface temperatures and its change in the northern plain, we conducted the measurement of temperature-depth profiles at 66 observation wells in Gunma and Tochigi Prefectures in 2011.

Distribution of observed subsurface temperature pattern changes with depth. Temperatures beneath the foot of the Asio Mountains are higher than the plain region at the shallow part (50m depth). At the deep part (100m depth), high temperatures are found regionally beneath the Watarasegawa lowland and the central part of the plain. This regional distribution of subsurface temperatures is considered to be formed by the effects of heat advection caused by groundwater flow, and three dimensional distribution of subsurface temperature shows the existence of local and regional groundwater flow systems in this area.

Moreover, the tendency and factor of decadal temperature changes were examined through a comparison between past (in 2001) and present (in 2011) temperature-depth profiles at 21 observation wells. All of temperature-depth profiles showed changes in a decade. Temperature increases were founded at the shallow part of 19 wells, and these were considered to be caused by effects of surface warming. Additionally, temperature changes were shown at the deep part such as 100m depth. Some observation wells also show large temperature changes at the specific depth. These temperature changes suggest that groundwater flows are changing caused by artificial effects such as groundwater pumping in the northern Kanto Plain.

Keywords: subsurface temperature, groudwater flow, surface warming, groundwater development, urbanization, Kanto Plain

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Potential estimation for geothermal heat exchanger system in Saitama prefecture

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Ground heat exchanger system is economical and environmentally friendly technology and widely used in Europe and North America, while it is rarely used in Japan. One of the causes is relatively complex topography and geological structure in Japan in comparison with those in Europe and North America. Complex structures produce regional differences in subsurface thermal properties and temperature structure, leading to regional variation in efficiency of heat exchanger system. It is thus important to evaluate available subsurface heat energy through thermal response tests and/or numerical simulation and to design appropriate systems (depth and number of boreholes for heat exchange). Information on subsurface environment in target areas is necessary for evaluation of potential subsurface heat energy, but little information has been published.

Center for Environmental Science in Saitama is a research institute established by a local government, Saitama prefecture, which is located on the north of Tokyo and has a population of over seven million. We have been collecting various subsurface environmental data in Saitama (e.g., lithological column data on over 10,000 boreholes). We have compiled the accumulated data and obtained new data (geological information, subsurface temperature distribution, and hydrogeological properties) to construct a database for application of ground heat exchanger systems in Saitama.

It is important to estimate demand for heat energy in the target areas as well as available subsurface heat energy. We therefore compile meteorological data (air temperature and solar radiation) necessary for estimation for the demand and investigate regional variation in meteorological condition.

We intend to disclose the database and research products using web GIS (geographic information system) in the future. It will assist spread of ground heat exchanger systems in the target areas. Investigation methods of subsurface environment survey and database construction can be applied to other areas.

We present results of numerical simulation of ground heat exchanger system operation based on the database. The amount of available heat energy and influence on subsurface thermal environment vary by up to about 20 % within the study area depending on geological, subsurface thermal condition,and ground water flow.

Keywords: geothermal heat exchanger, subsurface temperature, ground water, heat pump

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Study on the effect on rainfall storage of the river terrace sediment

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The river terrace consisting of the river sediment is mainly formed of gravel, and it penetrates much rain at the time of the storm and decrease a surface runoff. The infiltrated water flows on the basement slowly and make time lag with the surface runoff and discharge to the river. The peak of the river runoff is suppressed, and the flood of the river is controlled by this effect. In other words, river terrace sediment has a function of the rain storage, i.e., the sediment works to regulate a flood. In this study, the author reports the results of the estimated quantity of rain storage in the river terrace sediment at the time of the storm.

The study area is Nakamura district, located on the river terrace formed by the Sai river, flowing down from Akashina Azumino city, Nagano prefecture to the north. The area is between Sai river running to the north on east side and Nakayama mountains consisting of Tertiary deposits on west side, and the area consists of two terraces, i.e. the fifth (lower terrace) fourth (upper terrace) terrace. The author made a water table map of the study area and set up automatic water level recorders in several wells on the fourth and the fifth terrace for measuring the change in the groundwater level.

The author calculated the changes in groundwater level in the rainfall of August (precipitation 23mm/day) and the rainfall of September (precipitation 116mm/day). The change in groundwater level multiplied the porosity of the aquifer and the area of the surface of the terrace, is the change in storage of groundwater, i.e. the storage effect of the sediment. The quantity of the largest storage of the rain of August was estimated to be $3.5X10^4m^3$, and that of the rain of September was estimated to be $6.4X10^4m^3$.In other words, it was confirmed to be effective in delaying a runoff of the rainfall of 102.9-188.2mm.

The author also observed the change in storage at the irrigation period on the rice field.

In particularly, at the rainfall in August and September, the delayed peak appears in the groundwater level to the rainfall. Therefore, the rain, which fell on the ground surface, infiltrated to underground, and it made ”time lag” from surface runoff. Furthermore, it became clear that there were differences between the time lag of the peaks on the upper terrace and the lower terrace.

Keywords: river terrace, rainfall storage, river deposit, storm, flood